REMARKS

Claim Amendments

In accordance with the rejections stated within the office action, the claims have been amended to overcome the stated rejections. Explanations are provided below for the changes in the claims, as well as references in the Specification to substantiate the changes. A response to the rejections of the office action in light of the changes to the claims is also provided.

Claims 1-5, 11, 13-48, 50, 52-56, 59-60, and 67-74 have been amended, and new claims 79-102 added, as follows:

Independent Claim 1 has been modified to include the content of Claims 2 and 3. Claim 1 has also been modified to state that:

A) the use of the logical element claimed is for executing logical operations (Specification, p.11 L:1-5)

B) the two incoming light beams are superposed at the optical junction, thereby producing the said at least one outgoing light beam

C) the property of the outgoing light beam depends on the relative phase shift of the two incoming light beams

D) the relative phase shift comprises fractions of a cycle of any value in the range of 0 to 2π, including 0 and 2π, where a cycle is considered 2π radians (Specification, p.14 L:18-21)

The content of Claims 2 and 3 as well as A) have been added to claim 1 to differentiate the use and purpose of the present invention over the prior art, for example Lipson. D) is a limitation on what is stated in the specification of the present invention. The word "Other" (Specification, p.14 L:18) is meant to be understood as a fractional part of a cycle, including 0 and 2π.

Claims 2 and 3 have been cancelled.

A new Claim 79 has been drafted which states that the property of the outgoing light beam depends on the amplitude of the incoming light beams (Specification, p.11 L:7-10).

Claim 5 has been modified to state that the light intensity is a function of the relative phase shift of the incoming light beams (Specification, p.13 L:2-5).

Claim 11 has been cancelled.

Claims 14 has been modified to state that the characteristic can be either the wavelength or the polarization of the outgoing light beam (Specification, p.26 L:20-23, p.27 L:1, p.31 L:21-23).

New Claims 80 and 81 have been drafted which state that the logical operations executed by the logical element can be Boolean operations and Non-Boolean operations (Specification, p.16 L:3-6, p.25 L:11-12, p.25 L:20-22, p.26 L:6-10).

New Claim 82 has been drafted which states that the logical element can be implemented in a larger optical system (Specification, p.23 L:19-23, p.24 L:1-2).

Independent Claim 19 has been modified to include the contents of Claims 20 and 21. Claim 19 has also been modified to claim an optical system (Specification, p.23 L:19-23, p.24 L:1-2), instead of an optical circuitry, and to state that:

A) the use of the optical system claimed is for executing logical operations
B) the two incoming light beams are superposed at the optical junction, thereby producing the said at least one outgoing light beam
C) the property of the outgoing light beam depends on the relative phase shift of the two incoming light beams

D) the relative phase shift comprises fractions of a cycle, of any value in the range of 0 to 2π, including 0 and 2π, where a cycle is considered 2π radians

Claim 19 has been modified to claim an optical system to more precisely reflect the language of the description in the specification of the present invention. The redundant term "optical circuitry elements" of the original claim has been taken out. The modifications to Claim 19 are similar to the modification to Claim 1. The reasons for the modifications are therefore the same.

Claims 20, 21, 22, 23 and 24 have been cancelled.

New independent Claim 83 has been drafted which claims an optical resistor (Specification, p.38 L:12-17). Formerly, the optical resistor only appeared in older dependent Claims 30-33.

New Claims 84 and 85 have been drafted which state that the optical resistor of new independent Claim 83 can be implemented using a light absorbent material or by an optical drainage outlet (Specification, p.40 L:4-5, p.40 L:19-22). The wording of the claim "optical drainage outlet" is supported by the specification of the present invention as element 855 is referred to as an outlet.

Claim 34 - 34 have been cancelled.

New Claim 102 is claim 35 rewritten in independent form and modified to include the contents of Claim 36. Claim 102 has been written to claim a three-dimensional optical processor (Specification, p.20 L:6-12, p.22 L:21-22) and to state that:

A) the use of the optical processor claimed is for executing logical operations
B) the two incoming light beams are superposed at the optical junction, thereby producing the said at least one outgoing light beam

C) the property of the outgoing light beam depends on the relative phase shift of the two incoming light beams

D) the relative phase shift comprises fractions of a cycle, of any value in the range of 0 to 2π, including 0 and 2π, where a cycle is considered 2π radians

E) the optical processor also includes a detector for detecting a property of the outgoing light beam (Specification, p.20 L:10-12)

F) an outlet of an optical element in the optical processor can be coupled with an inlet of another optical element in the optical processor (Specification, p.21 L:22-23, p.22 L:1-7)

Claims 36, 37 and 38 have been cancelled.

New independent Claim 86 has been drafted which claims an optical processor which can execute operations in parallel (Specification, p.26 L:11-19).

New Claim 87 and 88 have been drafted which state that the operations done in parallel include multiple logical operations and switching actions (Specification p.26 L:11-13).

New Claims 89, 90, 91, 92, 93 and 94 have been drafted which state the use and implementation of a light separator to facilitate optical parallel processing (Specification, p.26 L:11-22, p.27 L:8-13, p.28 L:9-10, p.29 L:4-5, p.30 L:1-10, p.31 L:21-23, p.32 L:4-10, p.33 L:7-11, p.34 L:18, p.35 L:15-16).

New Claim 95 has been drafted which states that for each separated component of the outgoing light beam, there is a detector to detect a property of that separated component (Specification, p. 28 L:11-21, p.32 L:17-19).

New Claims 96, 97, 98 and 99 have been drafted which state that the incoming beams include either multiple polarizations or multiple wavelengths (Specification p.26 L:20-22, p.32 L:22-23, p.33 L:1).

Claim 39 has been modified to include the procedures of providing at least one group of light beams sharing a common characteristic (Specification, p.42 L:3-9), and detecting at least one property of the superposed light beam (Specification, p.43 L:22-23 and p.44 L:1-3).

Claim 42 has been amended to specify each light beam in a respective group of light beams has a respective phase shift and amplitude (Specification, p.42 L:12-16 and p.33 L:2-7).

Claim 44 has been modified to state that the common distinctive characteristic includes orthogonal polarization directions (Specification, p.26 L:22-23, p.27 L:1-7). This is to conform more precisely to the language in the specification of the present invention.

Claim 45 has been cancelled.

Claims 47 and 48 have been reworded.

Claim 52 has been modified to state that the relative phase shift comprises fractions of a cycle, of any value in the range of 0 to 2π, including 0 and 2π, where a cycle is considered 2π radians (Specification, p.14 L:18-21, p.41 L:16-20). This modification is a limitation on what is stated in the specification of the present invention.

Claims 53 and 54 have been cancelled.

Claim 56 has been reworded.

Claims 59 and 60 have been cancelled.

Claim 67 has been simplified to state that the superposed light beam is separated according to the distinctive characteristic (Specification, p.43 L:4-7). Claim 68 has been modified to state that the procedure of separating the superposed light beam includes directing

the light beam through at least one wavelength filter (Specification, p.43 L:11-15). Claim 69 has been reworded.

Claim 70 has been cancelled.

Claim 71 has been modified to state that the procedure of separating the superposed light beam includes direction the light beam through at least one polarizer (Specification, p.43 L:15-18). Claim 72 has been reworded. Claim 73 has been simplified to state that the distinctive characteristic can include both polarization and wavelength (Specification p.43 L:4-21).

New Claims 100 and 101 have been drafted which state that the logical operations claimed in independent Claim 39 can include Boolean and Non-Boolean operations (Specification, p.16 L:3-6, p.25 L:11-12, p.25 L:20-22, p.26 L:6-10).

Claim Objections

The informality in Claim 14, objected to in section 1 of the Office Action, has been amended in the new claims.

Claim Rejections

The office action rejects claims 1-5, 6-14, 19-24, 36-45, 47-52, 55-60 and 67-68, under paragraph 35 U.S.C. 102(b), as being anticipated by Lipson, et al., US Patent No. 5,225,887. Applicant respectfully traverses this rejection for the following reasons.

Lipson discloses an optical interferometer system (Lipson, C6:L40-42) and a method for preparing an optical fiber to be used with such a system (Lipson, C11:L18-64). The interferometer system is based upon the principles of a Michelson-type interferometer (Lipson, C6:L42-43). However, the present invention discloses a logical element, an optical system, an optical processor, and a method, for executing Boolean and Non-Boolean logical functions, using beams of light and the principles of interference. (See e.g. Claims 1, 19, 39, 86, and 102).

Lipson does not teach or suggest the use of interference between light beams to execute logical functions.

Furthermore, Lipson discloses optical detector units **36** and **37** positioned to detect at least one property of light (Lipson, C13). This property of light is used to measure the level or presence of an analyte (Lipson, C8:L2-18), or the concentration of a chemical species or analyte (Lipson, C8:L62-68). In contrast, the property of light detected by optical detectors of the present invention is used to assign logical values. (See e.g. Claims 1, 19, 39, 86, and 102).

Additionally, Lipson discloses that the property of light detected by an optical detector unit is the wavelength of light detected to correlate to the change of phase (Lipson, C14:L7-10). However, in the present invention, the property of light detected by an optical detector is the intensity of light detected to correlate to the change of phase. (See e.g. Claims 1 and 5).

Furthermore, unlike claim 30, Lipson does not disclose the construction or use of an optical resistor.

Additionally, the claims, as amended, do not read on Lipson with regards to Lipson's disclosure of electro-optic converters coupled to the inlet fibers (14, 15), a coupler unit to serve as a light separator that divides light based on wavelength and the obviousness of a circular interference pattern being created when two waves are superimposed.

The office action rejects claims 15-18, 30-35 and 69-78, under paragraph 35 U.S.C. 103(a), as being unpatentable over Lipson. Applicant respectfully traverses this rejection for the following reasons.

The amended claims of the present invention are not disclosed in Lipson, particularly with regards to claims 1-14, 19-24, 36-45, 47-52, 55-60 and 67-68, as stated and discussed in the preceding paragraphs.

As much as the replacement of filter elements 41 and 43 in Lipson, for dispersive materials, beam splitters and birefringent materials can be contended to have been obvious in the context of Lipson's invention, i.e. for detecting a property of light to measure the level or presence of an analyte (Lipson C8:L2-18), or the concentration of a chemical species or analyte (Lipson C8:L62-68), such a replacement is not obvious in the context of the present invention. A

worker skilled in the art would not know to replace filter elements 41 and 43 for dispersive materials, beam splitters and birefringent materials in order to detect a property of light in order to assign logical values to the light detected or to execute, say, Boolean and Non-Boolean logical functions with the light.

Lipson discloses the use of delay element 180 in an embodiment of his invention to ensure that back-reflection does not occur in the system. The use of optical resistors in the present invention is not to prevent back-reflection in the system, but to reduce the intensity of light traveling through the system (Specification, p.38 L:13-17). Therefore, the optical resistors in the specification are not similar to the delay element 180 of Lipson. Furthermore, it would not be obvious to one skilled in the art to modify the delay element 180 in Lipson, which serves the purpose of preventing back-reflection in the system, much like a diode, in general, prevents electric current from flowing in more than one direction in a system, to act as an optical resistor, which reduces the amount of light intensity traveling through the system without any delays.

The office action states that, "the incorporation of additional optical junctions...is known and would have been a mere matter of duplication of parts in order to form an optical network." The incorporation of additional optical junctions is not obvious from Lipson. Lipson describes an optical interferometer system (Lipson, C6:L40-42) and a method for preparing an optical fiber to be used with such a system (Lipson, C11:L18-64). In Lipson's system, there no is reason why optical junctions would need to be duplicated, as Lipson's system is used to measure the level or presence of an analyte (Lipson C8:L2-18), or the concentration of a chemical species or analyte (Lipson, C8:L62-68). Such a system has no relation to an optical network. Therefore, duplicating parts to form an optical network is not obvious from Lipson.

The office action rejects claims 25-29, 53-54 and 61-66, under paragraph 35 U.S.C. 103(a), as being unpatentable over Lipson in view of Sanders, et al., US Patent No. 5,999,304. Applicant respectfully traverses this rejection for the following reasons.

The office action states, "However, Lipson et al do not disclose the use of a phase shifter. However, such is known and disclosed by Sander et al...The incorporation of the phase shifter would allow for increase sensitivity of the device..." The phase shifter (Optical phase modulator **19**) disclosed in Sanders is used for the purpose of "converting the output signal of

photodetection system **14**, following a cosine function as indicated above, to a signal function that provides...information both as to the rate of rotation and the direction of that rotation about the axis of coil **10** (Sanders, C6:L26-33)."

However, the phase shifter disclosed herein is used for the purpose of creating an optical inverter, or a logical NOT gate (Specification, p.38 L9-11). Furthermore, the phase shifter disclosed herein is not used to increase the sensitivity of the device. Therefore, the phase shifter disclosed in Sanders is not similar to the phase shifter of the present invention. Also, it would not be obvious to one skilled in the art to take the phase shifter of Sanders and modify it to function as an optical inverter, in light of Lipson. Sanders does not disclose the use of interfering light waves to perform logical functions, such as Boolean and Non-Boolean functions, but rather discloses a fiber optic gyroscope with deadband error reduction, which is in a field of devices not related to the present invention.

CONCLUSION

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of all rejections and allowance of the claims, in due course. The Examiner is hereby cordially invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

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